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General Response

For each interrogatory, parts (a) and (b) are included in the response. Unless the response indicates otherwise, the answer to parts (c) and (e) is "none" for each interrogatory. For parts (d) and (f), Dr. Thomas B. Cochran (resume attached) is the only identified individual to date.

NRDC Contention 1 (formerly NRDC 2)

INTERROGATORY

- 1-1.a. What level of confidence does NRDC contend is adequate for determining that shut-down systems are reliable?
- b. Specify your basis for selecting the confidence level specified in response to a. above.

RESPONSE

1-1.a. Intervenors have not reached a final determination regarding the appropriate operational definition of "credible" as used in 10 CFR 100, and the level of confidence required for a determination of whether events are "credible" or "not credible." Intervenors will probably conclude that an appropriate acceptance criterion is to require that conservative calculations show that the probability of occurrence of explosive levels exceeding the 10 CFR 100 guideline values (as adjusted for applicability to LMFBRs) is lower than  $10^{-6}$  per year. Intervenors have described what is

General Questions

For each interrogatory, provide the following answers, in accordance with the terms of the parties' March 4, 1982, "Protocol for Discovery."

- a) Provide the direct answer to the question.
- b) Identify all documents and studies, and the particular parts thereof, relied upon by NRDC, now or in the past, which serve as the basis for the answer. In lieu thereof, at NRDC's option, a copy of such document and study may be attached to the answer.
- c) Identify principal documents and studies, and the particular parts thereof, specifically examined but not cited in (b). In lieu thereof, at NRDC's option, a copy of each such document and study may be attached to the answer.
- d) Identify by name, title, and affiliation the primary NRDC employee(s) or consultant(s) who provided the answer to the question, indicating the qualifications of that person to answer the question.
- e) Explain whether NRDC, et al., are presently engaged in or intend to engage in any further, ongoing research program which may affect its answer. Failure to provide such an answer means that NRDC, et al., do not intend to rely upon the existence of any such research at the LWA or construction permit hearing on the CRBR.
- f) Identify the expert(s), if any, which NRDC, et al., intend to have testify on the subject matter questioned, and state the qualifications of each such expert. This answer may be provided for each separate question or for a group of related questions. This answer need not be provided until NRDC, et al., have in fact identified the expert(s) in question or determined that no expert will testify, as long as such answer provides reasonable notice to the Staff.

meant by "conservative" in response to other interrogatories. See updated response to Interrogatory 3 of Applicants' First Set of Interrogatories to Intervenors.

b. See 20 CFR 100.

#### INTERROGATORIES

1-2 - 1-4 These Interrogatories have been withdrawn by Staff based on the Board's April 22, 1982, Order deferring Contention 1(b) until after the LWA-1 proceeding.

#### INTERROGATORY

1-5. Provide the reason(s) why you contend that CDAs should be included within the envelope of DBAs.

#### RESPONSE

1-5. The response to this Interrogatory is the same as the response to Interrogatory 3(f) of the Applicants' Fourth Set of Interrogatories to Intervenors.

#### INTERROGATORY

1-6. Considering the fact that the Staff requires that the CRBR accommodate CDAs, explain quantitatively how requiring CDAs to be included within the DBA envelope (i.e., requiring the CRBR to be designed to withstand CDAs), as you contend should be done, would enhance public safety.



RESPONSE

- 1-6. Intervenor's do not have a "quantitative" response to this Interrogatory at this time. A qualitative response to this Interrogatory can be found in discussions between Staff and ACRS members on March 30, 1982 (ACRS Transcripts, p. 103) and between Applicants and ACRS members on May 4, 1982 (Transcripts not available as of May 5, 1982). See vignette of Lee Strawbridge titled "Special Aspects of Margin Beyond the Design Base Analysis."

INTERROGATORY

- 1-7. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

- 1-8. Describe the transients you believe must be classified as anticipated transients within the meaning of your Contention 1(a).

RESPONSE

- 1-8. Generally we are referring to the same transients as referred to by Applicants and Staff in documents such as GEF-00523 and CRBRP-3, Vol. 1, Rev. 2. See also response to Interrogatory 1-9 below.

INTERROGATORY

- 1-9.a. Describe in detail the "other CDA initiators" that you believe must be evaluated to determine if their probabilities of occurrence are low enough to allow them to be excluded from the envelope of DBAs.
- b. Provide the bases and justification from your response to question a. above.

RESPONSE

- 1-9. As indicated in response to Interrogatory 2(b) of Applicants' Fourth Set of Interrogatories to Intervenor, Intervenor and Applicants are not necessarily in agreement regarding which faults (initiators of transients) are "anticipated" vs. "unlikely" or "extremely unlikely."

INTERROGATORY

- 1-10. Define what you would view as "reliable data" required for the analysis described in Contention 1(a).

RESPONSE

- 1-10. Intervenor's position is that it is not sufficient to develop a model or "reliability programs," get input data, plug it into the model or programs, and calculate an answer. Rather one must be able to demonstrate that the data base when used in the model or programs is a scientifically validated procedure for determining that

the predicted results represent an accurate estimate of the true values, that is, accurate to within the stated confidence intervals.

INTERROGATORIES

1-11 - 1-16 These Interrogatories have been withdrawn by Staff based on the Board's April 22, 1982, Order deferring Contention 1(b) until after the LWA-1 proceeding.

NRDC Contention 2 (formerly NRDC Contention 3)

INTERROGATORY

2-1. Describe the specific areas of the Applicants' and Staff's analyses of CDAs and their consequences which you believe are inadequate for purposes of licensing the CRBR.

RESPONSE

2-1. These are generally specified by the subparts (a)-(h) of Contention 2.

INTERROGATORY

2-2. Describe the specific areas of the Applicants' and Staff's analyses of CDAs and their consequences which you believe are inadequate for purposes of performing the NEPA cost-benefit analysis for the CRBR.

RESPONSE

2-2. The response to this Interrogatory is the same as the response to Interrogatory 2-1 above. Intervenors would also note that NEPA requires an analysis of the proposed action and not of "a reactor of the general size and type as that proposed." Intervenors believe this requires an analysis of the health and environmental risks of accidents of the CRBR as proposed and the costs and benefits (likelihood of meeting the programmatic objectives) of the CRBR as proposed and partially constructed and not a hypothetical reactor of the general size and type as that proposed.

INTERROGATORIES

2-3. - 2.8. These Interrogatories have been withdrawn by Staff.

INTERROGATORY

- 2-9. Regarding Contention 2(b):
- a. What does NRDC contend in the first part of this contention which is different from what is contended in new Contention 1 and the first part of subpart (a) to new Contention 1?
  - b. Define what NRDC means by "explosive potential" in 2(b).

- c. Describe the methodology by which a "conservative estimate of the fission product release from [CDA]" could be performed that you contend would be adequate; specify the aspects of this methodology.
- d. Explain why the reference in 2(b) to fission product release from CDAs is not subsumed in the first part of 2(c).

RESPONSE

2-9.a. Contention 1 says that CDAs should be within the DBA envelope. Intervenors believe this to be the case because of the relatively high probability of CDAs with full core involvement. Non-energetic core melt and reactor vessel penetration should be treated as design basis events and should be accommodated by incorporation of a core catcher and other design features even though non-energetic scenarios are not used in the determination of the site suitability source term. Contention 2(b) is a prescription for establishing the source term, where it is derived using conservative assumptions rather than "best estimates" of CDA phenomena.

- b. Intervenors prefer the term "explosion" to "energetic core disruptive accident" because it is more descriptive of the phenomena and can be understood by members of the general public unschooled in the

erudite language of fast reactor engineers. "Explosive potential" means "the size of the explosion which is possible," as, for example, the "explosive potential" of the Trinity and Nagasaki bombs was on the order of 19 to 23 kilotons of TNT equivalent.

- c. When analyzing the CDAs where uncertainties exist, worst case or upper limit assumptions should be made for variables, mechanisms, and related phenomena.
- d. The references to the analysis of fission product release are overlapping.

INTERROGATORY

2-10. Regarding Contention 2(c):

2-10.a.-c. These Interrogatories have been withdrawn by Staff.

INTERROGATORY

2-10.d. Specify the environmental conditions which NRDC contends should be considered in the radiological source term analysis.

RESPONSE

2-10.d. Staff is asking Intervenors to do its job. Intervenors have not performed the analysis that would be required to specify these environmental conditions. These conditions might be qualitatively similar to those that would be derived using an approach as described in

CRBRP-1, Chapter 7, although Intervenors attach no quantitative significance to the results of the CRBRP-1 analysis.

INTERROGATORY

2-10.e. Specify (1) what NRDC contends should be the maximum credible sodium release following a CDA and (2) the environmental conditions caused by such a sodium release for determining the radiological source term pathway analysis.

RESPONSE

2-10.e. These cannot be specified without performing a comprehensive analysis of CDAs as prescribed in Contention 2(b). Staff, not Intervenors, should perform this analysis.

INTERROGATORY

2-10.f. Specify the bases for the response to e. above, indicating the criteria, methodology, data, and other factors upon which you rely in specifying the release and environmental conditions.

RESPONSE

2-10.f. See response to Interrogatory 2-10.e. above.

(There is no Interrogatory 2-11.)



INTERROGATORY

2-12. Regarding Contention 2(d):

2-12.a.-b. These Interrogatories have been withdrawn by Staff based on the Board's April 22, 1982, Order regarding the scope of the LWA-1 proceeding.

INTERROGATORY

2-12.c. Does NRDC contend that it is impossible to design a containment for the CRBR which is adequate to reduce calculated offsite doses to an acceptable level?

d. If the answer to c. above is yes, specify the bases, i.e., methodology, upon which you rely to arrive at that conclusion.

e. If the answer to c. above is no, specify the containment designs that you are aware of which you contend would be adequate to reduce offsite doses to an acceptable level; indicate the specifics of the CRBR containment design which differ materially from these acceptable designs.

f. & g. These Interrogatories have been withdrawn by Staff based on the Board's April 20, 1982, ruling deferring Contention 11(a) to the CP level.

h. Define what the offsite doses you contend are acceptable. Provide the bases upon which you rely for your response to the extent that these doses differ from NRC regulatory requirements. Please be specific.

RESPONSE

2-12.c. No.

d. Not applicable.

e. Intervenors are not aware of any.

h. Intervenors believe all exposure to ionizing radiation should be kept as low as practical (reasonably achievable) and consequently "acceptable doses" cannot be quantified on the basis of the data provided by Applicants and Staff. See also response to Interrogatory 6(a) of Applicants' Fourth Set of Interrogatories to Intervenors.

INTERROGATORY

2-13. Regarding Contention 2(f):

2-13.a. Specify the aspects of those computer models (including computer codes) used by the Applicants and the Staff (CRAC and TRAC codes only) for the CRBR which NRDC currently contends are invalid within the meaning of Contention 2(f).

b. Specify the bases upon which you rely to conclude that the models and codes set forth in response to a. above are invalid.

RESPONSE

2-13.a. Intervenors have not yet reviewed the CRAC and TRAC codes. Intervenors have not yet analyzed Applicants' updated responses to earlier discovery concerning computer codes.

b. Not applicable.

INTERROGATORY

2-13.c. Identify the methodology, tests, data, and other factors which NRDC contends must be utilized in order to demonstrate that the computer models and codes referenced in Contention 2(f) are adequately validated, verified, and documented.

RESPONSE

2-13.c. Having not examined the TRAC and CRAC codes at this time, Intervenor cannot answer this question for these codes beyond a general prescription along the lines of the response to Interrogatory 1-10 above (recognizing the codes serve a different purpose). With respect to Applicants' codes, see response to Interrogatory 2-13.a. above.

INTERROGATORY

2-13.d. Does NRDC contend that any of the computer models and codes referenced in the Applicants' or the Staff's CDA analysis accurately represent the physical phenomena and principles which control the response of the CRBR to CDAs? If so, specify which models and codes are valid.

RESPONSE

2-13.d. No, although some are obviously better than others. An ACRS consultant at the May 4, 1982, ACRS meeting, for example, stated that REXCO was a good code. The codes which are used to predict the response of the CRBR to CDAs, prior to fuel or cladding melt and relocation, are probably reasonably accurate. Intervenors cannot give a more detailed response at this time because we have not been provided the kind of data we requested in earlier discovery regarding code validation. See response to Interrogatory 2-14.c. and d. below.

INTERROGATORY

2-13.e. Specify the physical phenomena and principles, within the meaning of your Contention 2(f), which you contend control the response of CRBR to CDAs.

RESPONSE

2-13.e. "Physical phenomena" refers to the response of materials in the reactor core, vessel, and containment structure during a CDA, e.g., fuel failure propagation, cladding and fuel melt, and relocation, hydrodynamic disassembly, etc. "Principles" refers to the laws of physics.

INTERROGATORY

2-13.f. What criteria do you contend must be utilized to provide assurance that computer models accurately represent the physical phenomena and principles which control the response of CRBR to CDAs?

RESPONSE

2-13.f. We do not specify criteria as such. We believe a scientifically valid procedure should be used to verify the accuracy of the codes and determine the range of parameters over which they can be used to accurately predict events. See response to Interrogatories 2-13.h. and 2-14.b. below.

(There is no Interrogatory 2-13.g.)

INTERROGATORY

2-13.h. In the context of subcontention 2(f), define what you mean by:

- 1) adequately documented
- 2) adequately verified
- 3) adequately validated.

i. If you distinguish between verified and validated, explain this difference.

RESPONSE

2-13.h. 1) "Adequately documented" means sufficiently described so that the reader of the description can readily determine the methodology employed, the range

of parameters over which the code can be used to accurately predict events, the analyses, test data, etc., which form the basis for validation that the code accurately predicts events over this range, and the steps taken to assure that the output of the model or code accurately reflects the assumptions it purports to utilize. In other words, there should be pulled together in one place -- that is, in a minimum number of documents -- the body of information that would enable the reader to establish whether, or to what extent, the models or codes accurately represent the physical phenomena and principles which it purports to represent.

2) "Verify" means "to check or test the accuracy or exactness of."

3) "Validate" means "to make valid, or confirm."

- i. There is no significant distinction implied. If tests are performed to verify the accuracy of a code, and the results demonstrate that the code is in substantial error, we would say that the code has not been shown to be valid, i.e., founded on truth or fact.

#### INTERROGATORY

2-13.j. What is meant by "applicable experimental data?"

RESPONSE

2-13.j. Intervenors do not understand why Staff finds it necessary to ask this question. "Applicable," "experimental," and "data" are among the most commonly used terms in any field of applied science. You cannot measure the distance to the moon by laying a rule alongside an inchworm.

INTERROGATORY

2-14. Regarding Contention 2(q):

2-14.a. What methodology, tests, data, or other factors do you contend should be utilized to establish that the input data and assumptions for the computer models and codes are adequately documented or verified within the meaning of your Contention 2(q)?

b. What are the specific bases upon which you rely in arriving at the factors specified in response to a. above?

RESPONSE

2-14.a. Intervenors believe applicable experimental data and the scientific method should be utilized. See response to Interrogatory 2-13 above.

b. By scientific method, Intervenors are referring to the methods of rational science that date back to the 17th Century and based upon the empiricism and inductive



methods of Sir Francis Bacon, and upon the deductive principles of Rene Descartes. Using these procedures would free Applicants and Staff from arbitrary, unfounded, and superstitious assumptions and political pressure, as well as assumptions based on nuclear theology and dogma and an accretion of folk wisdom.

INTERROGATORY

2-14.c. Describe in detail any and all "input data for the computer models and codes" that you contend are not adequately documented and, in a separate list, those that are not adequately verified.

d. Describe in detail any and all "assumptions for the computer models and codes" which you contend are not adequately documented and, in a separate list, those that are not adequately verified.

RESPONSE

2-14.c.&d. Intervenors cannot answer these Interrogatories at this time. We have attempted to obtain the information necessary to answer these interrogatories through discovery. Unfortunately, since April 25, 1977, many of the data, codes, and code assumptions used by Applicants and Staff have changed. We need to analyze the updated responses by Applicants and Staff to earlier discovery and

responses by Applicants and Staff to new first round discovery before we can answer these questions. A cursory review of the responses received to date leads Intervenor's to conclude that we will be unable to "describe in detail any and all input data and assumptions" if responses to our discovery requests are going to be along the lines of Staff's updated responses to Interrogatories 1-7 of Intervenor's Fourth Set. In the meantime, it is safe to assume that our principal concern is with regard to modeling of CDA events following loss of core geometry.

INTERROGATORY

2-15. Regarding Contention 2(h):

2-15.a. Explain in detail what you contend to be the relationship between establishing the energetics of the CDA and the containment of the source term for post accident radiological analysis.

RESPONSE

2-15.a. The relationship is set forth in 10 CFR 100.

INTERROGATORY

2-15.b. Define what you mean by post accident radiological analysis.

RESPONSE

2-15.b. The analysis of radiation absorbed dose following a postulated release of fission products and fuel, not exceeded by the release from any accident considered credible, for purposes of assessing the suitability of the site as required by 10 CFR 100. In other words, all the analyses used to estimate the relationship between absorbed dose and a postulated source term release.

INTERROGATORY

2-15.c. Does subcontention 2(h) represent NRDC's summation of its conclusions set forth in Contention 2(a) through 2(q)?

d. If the answer to c. above is yes, does 2(h) rely solely on the conclusions set forth in 2(a) through 2(q)?

e. If the answer to c. or d. above is no, set forth the specific conclusions or arguments upon which you rely in support of your conclusion in 2(h).

RESPONSE

2-15.c. No.

d. Not applicable.

e. It is not necessary for every contention 2(a) through 2(q) to be valid separately in order for 2(h) to be valid, although 2(h) does rely to some extent on those conclusions.

INTERROGATORY

2-15.f. Does your Contention 2(h) rely solely on the bases that you have asserted for Contention 2(a) through (q) which you have set forth in response to interrogatories 2-1 through 2-14 above?

g. If the answer to c. above is no, specify what other factors, including the bases for each factor, upon which you rely in support of your conclusion in Contention 2(h), to the extent not provided in response to c. above.

RESPONSE

2-15.f. No.

g. See response to Interrogatory 2-15.e. above.

Regarding Contention 3 (formerly NRDC Contention 4)

INTERROGATORY

3-1. This Interrogatory has been withdrawn by Staff based on the Board's April 22, 1982, Order limiting the scope of the LWA-1 proceeding.

INTERROGATORY

3-2. Regarding Contention 3(b):

3-2.a. What acceptance criteria does NRDC contend must be satisfied in determining whether Applicant's and

Staff's analysis of potential accident initiators, sequences, and events are sufficiently comprehensive to assure that analysis of the DBAs will envelop the entire spectrum of credible accident initiators, sequences, and events?

- b. Specify the bases which NRDC contends support the acceptance criteria set forth in response to a. above.

RESPONSE

- 3-2.a. See updated response to Interrogatory 4 of Applicants' First Set of Interrogatories to NRDC, et al.
- b. See response to Interrogatory 3-2.a. above.

INTERROGATORY

- 3-2.c. Specify the potential accident initiators, sequences, and events which you contend were not adequately considered, or were not considered, by the Applicants or Staff and which you contend should be factored into the analysis of DBAs for the CRBR to assure that DBAs are adequately analyzed.
- d. Provide the specific bases upon which NRDC relies to support its contention that the factors specified in response to c. above must be included in the DBA analysis.

RESPONSE

- 3-2.c. See updated response to Interrogatory 4 of Applicants' First Set of Interrogatories to NRDC, et al., and response to Interrogatory 2(b) of Applicants' Fourth Set of Interrogatories to Intervenor.
- d. See response to Interrogatory 3(f) of Applicants' Fourth Set of Interrogatories to Intervenor, and the Energy Daily, May 4, 1982, pp. 1, 4.

INTERROGATORY

- 3-2.e. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

- 3-3. Regarding Contention 3(c):
- 3-3.a. Identify those accidents addressed by contention 3(c) which you contend are inadequately analyzed, identifying the specific aspects of the accidents which have not been adequately analyzed, and specifying which aspects deal with core meltthrough and which with sodium-concrete interactions.
- b. Indicate the specific bases upon which you rely to support your conclusion that the aspects of the accidents identified in response to a. above are inadequately analyzed.

RESPONSE

- 3-3.a. The Contention explicitly identifies the accidents as "those associated with core meltthrough following loss of core geometry ...". If Staff includes CDAs in the envelope of DBAs, it would be able, using the methodology and standards it applies to DBAs, to specify more fully the characteristics of these accidents. (See also CRBRP-3.)
- b. See response to Interrogatory 3-3.a. above.

INTERROGATORY

- 3-3.c. Specify the acceptance criteria, data, tests, or other factors which you contend must be utilized to assure that core meltthrough accidents are adequately analyzed.
- d. Identify the specific bases upon which you rely to contend that the acceptance criteria, data, tests, or other factors identified in response to c. above are appropriate and necessary to assure that the accidents are adequately analyzed.

RESPONSE

- 3-3.c. Intervenorors have not developed at this time specific acceptance criteria, which Intervenorors contend must be utilized.
- d. See response to Interrogatory 3-3.c. above.



INTERROGATORY

3-3.e. Explain whether or not you contend that a core meltthrough necessarily occurs following a loss of core geometry; provide your reasons supporting this conclusion.

RESPONSE

3-3.e. Intervenors do not contend that a core meltthrough necessarily occurs following a loss of core geometry. The probability of a CDA progressing to full core involvement and meltthrough is high. A prudent or conservative assumption would be to assume the probability is unity. See CRBRP-1.

INTERROGATORY

3-3.f. Define what you mean by loss of core geometry in this subcontention.

RESPONSE

3-3.f. As defined in CRBRP-1 at Vol. 1, pp. E-23 and 3-17, except that Intervenors do not endorse the characterization of its probability as "highly improbable."

INTERROGATORY

3-4. Regarding Contention 3(d):

3-4.a. Specify the methods by which you contend human error can initiate, exacerbate, or interfere with the

mitigation of accidents of a reactor of the general size and type as that proposed by Applicants. The examples must be carried far enough to clearly demonstrate how the consequences would be significantly worse had the human error not occurred.

- b. Provide the bases upon which you rely to support your answer to a. above.

RESPONSE

- 3-4.a. See response to Interrogatory 4(b) of Applicants' Fourth Set of Interrogatories to Intervenors.
- b. See response to Interrogatory 3-4.a. above.

NRDC Contention 5 (formerly NRDC 6)

The following interrogatories relate to NRDC Contention 5(a).

INTERROGATORY

5(a)-1.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(a)-1.b. What criteria does NRDC utilize in determining whether site meteorology is "less favorable"? What are the bases for NRDC's selection of these criteria?

RESPONSE

5(a)-1.b. Intervenorors are referring to comparison of the dose to the maximally exposed individual in the general public and the population dose commitment at the CRBR site with other reasonable alternatives. Intervenorors also believe that, in light of the lessons learned from the TMI accident, in comparing the proposed site with alternatives, the site selection should be weighted heavily in favor of sites where the maximally exposed individual and the population dose commitment are substantially smaller due to more favorable population and meteorological conditions (i.e., favor remote sites). In effect, siting should be treated as though it were an independent "barrier" or "safeguard" as part of the

defense-in-depth approach to reactor safety, as opposed to the historical approach of allowing poor site characteristics to be accommodated by engineering features associated with the containment; that is, with the limitation on siting being defined only by 10 CFR 100 requirements.

INTERROGATORY

5(a)-2.a. Are there meteorological parameters or factors, other than wind speed and inversion conditions, that Intervenor believe must be utilized in evaluating site meteorology?

RESPONSE

5(a)-2.a. NRDC believes the best available model(s) should be used to predict the effects of meteorological factors, e.g., wind speed and inversion conditions, in assessments of the quantity of radioactivity inhaled/unit of activity released. The model(s) should be applied in a conservative manner.

INTERROGATORY

5(a)-2.b. If so, list and describe these parameters, and provide the bases for selection of these parameters. Rank the parameters in order of importance in the evaluation of site meteorology.

RESPONSE

5(a)-2.b. See answer to Interrogatory 5(a)-2.a. above.

INTERROGATORY

5(a)-2.c. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(a)-3.a. What are the bases for NRDC's contention that sites other than Clinch River have more favorable wind speed and inversion conditions?

RESPONSE

5(a)-3.a. Section 9.2 of the CRBR FES, and letter dated Oct. 31, 1974, from Richard P. Denise, NRC Staff, to Peter S. Van Nort, PMC.

INTERROGATORY

5(a)-3.b. List, and provide supporting documentation, for all sites which NRDC claims have more favorable wind speed and inversion conditions, compared with the CRBR site.

RESPONSE

5(a)-3.b. Intervenors are not required to answer this question, as it requests Intervenors to perform the analysis required of Staff in its NEPA review of the CRBR. See Transcript of Special Meeting with Counsel, April 20, 1982, pp. 669-670 [statement of Chairman Miller].

INTERROGATORY

5(a)-4. List, and provide supporting documentation, for sites which NRDC claims in Contention 5(a)(2) have more favorable meteorological characteristics, compared with the CRBR site.

RESPONSE

5(a)-4. Staff has identified several such sites in the FES, §9.2. The answer to this question should logically flow from an analysis of alternative CRBR sites on properties owned or controlled by DOE and TVA in an adequate NEPA review of the CRBR by the Staff.

INTERROGATORY

5(a)-5. List, and describe with particularity the meteorological disadvantages of the CRBR site. Provide the bases for NRDC's response.

RESPONSE

5(a)-5. Wind speed and inversion conditions are cited in Contention 5(a)(1) as conditions less favorable at the CRBR site. Wind direction plays an obvious role in predicting the direction of the plume, knowledge necessary to estimate doses. Surely Staff has sufficient familiarity with the subject and has exercised its own meteorological models enough to know and describe with particularity which

parameters are most important to an accurate or bounding prediction of dose, and presumably Staff has performed sufficient sensitivity analyses to understand how the various parameters and assumptions affect calculations of dose. Intervenor's have not performed such analyses and therefore cannot further describe with particularity the meteorological disadvantages other than to refer Staff to the answer to Interrogatory 5(a)-1 above.

INTERROGATORY

5(a)-6. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(a)-7.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(a)-7.b. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

5(a)-8. This Interrogatory has been withdrawn by the Staff as duplicative of Applicants' discovery request.

INTERROGATORY

5(a)-9.a. This Interrogatory has been withdrawn by Staff.



INTERROGATORY

5(a)-9.b. List all "population characteristics" which NRDC believes are relevant in assessing site suitability for a breeder reactor.

RESPONSE

5(a)-9.b. Intervenors believe the best available model(s) should be used to predict the effect of population characteristics in assessments of the quantity of radioactivity inhaled/unit of activity released.

INTERROGATORY

5(a)-9.c. Does NRDC contend that there are disadvantageous population characteristics, other than population density, associated with the CRBR site? If so, please list, describe and provide the basis for all disadvantageous population characteristics associated with the CRBR site.

RESPONSE

5(a)-9.c. No.

INTERROGATORY

5(a)-10.a. Does NRDC contend that the analysis of alternative sites meteorology and population density contained in the Staff Final Environmental Statement ("FES") is inadequate, and/or gave insufficient weight to these factors?

RESPONSE

5(a)-10.a. Yes.

INTERROGATORY

5(a)-10.b. If so, please list, describe, and provide the bases for all NRDC-perceived inadequacies in the FES.

RESPONSE

5(a)-10.b. The documentation is inadequate to fully determine how the Staff calculations were performed. Staff has limited its comparison of the dose to the maximum exposed individual and the population dose commitment at the CRBR site to DOE reservations. Staff does not appear to have performed a similar analysis of the alternative sites on the TVA system. Staff has not updated its analysis using the newer meteorological data provided by Applicants. Finally, where the comparisons were previously made (FES), the Staff drew the wrong conclusions from the results, e.g., that reduction in accident risks at alternative sites was outweighed by other factors such as cost and timeliness.

INTERROGATORY

5(a)-11.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(a)-11.b. What are the criteria or parameters which NRDC contends should be used in determining the "weight" to be given to meteorological and population factors? What are the bases for NRDC's response?

RESPONSE

5(a)-11.b. The answer to this question is the same as the answer to Interrogatory 5(a)-1.b. above.

INTERROGATORY

5(a)-11.c. Does NRDC contend that meteorology is a major or overriding factor in identifying suitable sites for a breeder reactor? If so, state the reasons for this conclusion and provide the bases for the response.

RESPONSE

5(a)-11.c. See answer to Interrogatory 5(a)-1.b. above.

INTERROGATORY

5(a)-11.d. What numerical weight should be assigned to meteorology as a criterion in evaluating alternative sites for the CRBR? How does NRDC derive this numerical weight?

RESPONSE

5(a)-11.d. Intervenors do not claim that a numerical weight should be assigned to meteorology as a criterion in evaluating alternative sites. See answer to Interrogatory 5(a)-1.b. above.

INTERROGATORY

5(a)-11.e. Does NRDC contend that population characteristics are a major or overriding factor in identifying suitable sites for a breeder reactor? If so, state the reasons for this conclusion and provide the bases for the response.

RESPONSE

5(a)-11.e. Population characteristics are a major factor when taken together with meteorological factors. See answer to Interrogatory 5(a)-1.b. above.

INTERROGATORY

5(a)-11.f. What numerical weight should be assigned to population characteristics as a criterion in evaluating alternative sites for the CRBR? What methodology does NRDC use to derive this numerical weight?

RESPONSE

5(a)-11.f. Intervenors do not claim that a numerical weight should be assigned to population characteristics as a criterion in evaluating alternative sites. See answer to Interrogatory 5(a)-1.b. above.

The following interrogatories relate to Contention 5(b).

INTERROGATORY

5(b)-1. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

5(b)-2. Define "close proximity" to the CRBR site. State the maximum radial distance from the CRBR plant itself that NRDC contends would constitute "close proximity".

RESPONSE

5(b)-2. All facilities within a radial distance defined by the distance between the center of the CRBR reactor core and the furthest point on the Y-12 site would suffice to define "close proximity" as used in Contention 5(b).

INTERROGATORY

5(b)-3. Does NRDC contend that the distance which constitutes "close proximity" to CRBR is fixed? If not, list and describe all variables that may affect the distance which constitutes "close proximity".

RESPONSE

5(b)-3. No. Intervenors do not believe Staff should perform pirouettes around precise definitions of "close

proximity", but should focus on the effects a catastrophic accident at CRBR could have on nearby facilities in terms of national security and national energy security.

INTERROGATORY

5(b)-4. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(b)-5. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(b)-6. Does "evacuation" include a partial shutdown of the facilities identified in Interrogatory 5(b)-1? If so, please specify the percentage decrease in the operating level of those facilities which NRDC contends will constitute "evacuation". If a percentage cannot be specified, so state, and give reasons for this position. If NRDC feels that other criteria or parameters are more appropriate to measure the degree of shutdown of a facility, identify those criteria or parameters and the basis for relying on those criteria.

RESPONSE

5(b)-6. Whether or not the facilities could reasonably be expected to operate, at full operations or at a

reduced level, would depend on how many people were evacuated and the functions of those remaining. The degree of evacuation is likely to be a function of the perceived risk.

INTERROGATORY

5(b)-7. State the minimum period of time which NRDC contends constitutes a "long-term" evacuation. What is NRDC's basis for specifying this time period? If NRDC cannot state a minimum time period, what criteria or parameters does NRDC contend should be taken into account in determining the time period which constitutes a "long-term" evacuation?

RESPONSE

5(b)-7. NRDC does not have a precise minimum period in mind. The term is purposely left vague, because it cannot be determined independently of the nature of the facility. If the loss of the facility for even one day would have an adverse effect on national security, then obviously the effects of evacuation for one day should be considered. A more reasonable approach for attacking this particular question would be to first determine whether evacuation of the facility for any period would have an adverse effect on national security or energy security.

If so, it should then be determined whether there is some minimum period of time during which the facility could be evacuated without having an adverse effect.

INTERROGATORY

5(b)-8. Specify with particularity the accidents or accident consequences at CRBR which NRDC contends may result in long-term evacuation of the facilities identified in Interrogatory 5(b)-1.

RESPONSE

5(b)-8. Any accident releasing, or threatening to release, quantities of radioactive material sufficient to cause responsible people to evacuate the facility. In the event of a non-energetic CDA involving the full core, where reactor vessel meltthrough is predicted to occur in less than 30 minutes, even if the accident did not ultimately challenge the 10 CFR 100 dose limits, it is difficult for Intervenor to believe that an evacuation of the nearby facilities would not occur. If Applicants' reference design were adopted, where there is no core catcher, Intervenor can envision a substantial period of time during which evacuation would be considered a prudent course of action, particularly in light of the events that took place in the days following the



TMI accident. Were an energetic CDA to occur, the situation could be far worse.

INTERROGATORY

5(b)-9. Specify with particularity the (1) national security; and (2) national energy supply "risks" which NRDC contends are unacceptable if an accident at CRBR caused a long-term evacuation of the facilities identified in Interrogatory 5(b)-1. This list should be inclusive of every national security and national energy supply risk which NRDC contends are raised by a possible accident at CRBR.

RESPONSE

5(b)-9. Risks include, but are not necessarily limited to the following:

(1) Inability to meet the nuclear weapons production schedule or requirements for surge capacity as set forth in the Nuclear Weapons Stockpile Memorandum current at the time of the accident.

(2) Inability to meet uranium enrichment demands under DOE contracts at the time of the accident.

Staff is asking Intervenors to do its work. Staff is the appropriate agency to identify the risks associated with the operation of the CRBR in order to perform an adequate NEPA analysis.

INTERROGATORY

5(b)-10. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

5(b)-11. Specify the criteria which NRDC contends must be used in determining whether a risk is "unacceptable".

RESPONSE

5(b)-11. The criteria Intervenor has in mind is summing the benefits and cost of the proposed action, comparing the sum with that of each reasonable alternative and choosing the alternative with the highest benefit to cost ratio. Since all benefits and risks cannot be numerically quantified, judgments must be made regarding the weight to be given the nonquantifiable benefits and risks. In this regard it is imperative that the discussions of risks and benefits be complete and accurate.

INTERROGATORY

5(b)-12. Does NRDC contend that an identified risk to national security or the national energy supply is per se an unacceptable risk, regardless of the probability of its occurrence?

RESPONSE

5(b)-12. No.

Contention 6 (formerly NRDC 9)

INTERROGATORY

6-1. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

6-2. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

6-3. List each type of facility in the "fuel cycle" in which "the ER and FES do not include an adequate analysis."

RESPONSE

6-3. See updated response to Interrogatory 2 (Contention 6 (Old 9)) of NRC's Fourth Set of Interrogatories to NRDC, et al., and response to Interrogatory 7a of the Applicants' First Set of Interrogatories to Intervenors.

INTERROGATORY

6-4. For each facility listed in response to question 6-3, provide the basis (i.e., methodology for analysis, and any documents used in that analysis) for your statement that "the ER and FES do not include an adequate analysis of the environmental impact" for that particular facility.

RESPONSE

6-4. See the response to Interrogatory 6-e above.

INTERROGATORY

6-5. What is the source (i.e., radiation and/or chemicals) of the environmental impact referred to in Contention 6.

RESPONSE

6-5. Radiation and chemicals.

Contention 6(b) (1)

INTERROGATORY

6-6.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

6-6.b. List the type of impacts of reprocessing of spent fuel and plutonium separation that are "not included" in the ER.

RESPONSE

6-6.b. One of the principal alternatives for obtaining plutonium for the CRBR is to construct a shear/leach head-end facility on one of the existing DOE reprocessing facilities. Intervenors believe one of the reprocessing canyons at Savannah River is the most logical choice. In any event, Intervenors seriously doubt that any of the DOE reprocessing

plants have DFs as good as those assumed in WASH-1535 for the model LMFBR reprocessing plant. Staff must consider and analyze in the FES the probable fuel cycle facilities where they are reasonably identifiable and not rely on hypothetical model facilities with better DFs. Staff should understand that the alternative sources of fuel for the CRBR are quite limited and that they clearly define the available fuel cycle facilities associated with the front end of the CRBR fuel cycle. See Argonne National Laboratory, Evaluation of Barnwell Nuclear Fuel Plant (BNFP) (Executive Summary), December 1980.

INTERROGATORY

6-6.c. List the types of impacts of reprocessing of spent fuel and plutonium separation that are "not included" in the FES.

RESPONSE

6-6.c. See response to Interrogatory 6-6.b. above.

INTERROGATORY

6-6.d. List the types of impacts of reprocessing of spent fuel and plutonium separation that are "inadequately assessed" in the FES.

RESPONSE

6-6.d. All of them. See FES Appendix D.

INTERROGATORY

6-6.e. List the types of impacts of reprocessing of spent fuel and plutonium separation that are "inadequately assessed" in the ER.

RESPONSE

6-6.e. All of them. See ER Section 5.71.

NRDC Contention 7 (formerly NRDC 10)

INTERROGATORY

7-1. Assuming no technical difficulties in implementing the program, explain fully what factors NRDC believes would result in the CRBR program not fulfilling the objectives of the LMPBR Program on a timely basis.

RESPONSE

7-1. The answer depends on how broadly you define "technical difficulties" and "implementing the program." Staff should examine carefully at least three considerations:

1) the extent to which fuel availability will restrict the period of operation needed to demonstrate reliability, technical performance, etc.;

2) whether CRBR can demonstrate anything positive regarding the economics of breeders, given what we know from French experience and the extent to which the final design requirements (e.g., reference vs. parallel design) will affect the ability of the CRBR to meet this objective;

3) whether CRBR will meet the timeliness objective due to delays in CRBR construction and operation caused by the need to refabricate major components to meet NRC licensing requirements.

NRDC Contention 7(c) (formerly NRDC 10(g))

INTERROGATORY

7(c)-1 List all environmental and safety characteristics which NRDC contends must be utilized in assessing the suitability of alternate sites for CRBR.

RESPONSE

7(c)-1 Intervenors have focussed on meteorology and population and colocation of fuel cycle facilities where directly weapons usable materials are

processed and handled. NRC is required under NEPA to go beyond consideration of these factors.

Intervenors have not made an assessment of all the characteristics that must be considered, and are not required to perform Staff's work.

INTERROGATORY

7(c)-2(a) State the numerical "weight" which NRDC contends should be given to the environmental and safety characteristics identified in Interrogatory 7(c)-1.

(b) What criteria does NRDC contend should be utilized in determining the numerical "weight" to be given to each of the environmental and safety characteristics identified in Interrogatory 7(c)-1?

RESPONSE

7(c)-2(a)

and (b) Intervenors do not specify a numerical weight to be given these characteristics.

INTERROGATORY

7(c)-3(a) List and describe all "site selection criteria" which NRDC believes should be used in identifying alternative sites. Are these criteria the same as the environmental and safety characteristics identified by NRDC in response to Interrogatory 7(c)-1?



RESPONSE

7(c)-3(a) The answer is the same as that given to Interrogatory 5(b)-11, above.

INTERROGATORY

7(c)-3(b) This Interrogatory has been withdrawn by Staff.

INTERROGATORY

7(c)-4 In addition to the specific alternative sites (i.e., Hanford Reservation, Nevada Test Site) which are identified by NRDC, are there other sites which NRDC contends must be evaluated? If so, please list these sites and provide the basis for NRDC's contention that these sites may offer "substantially better" characteristics.

RESPONSE

7(c)-4 The TVA sites, particularly those where LWR units have been cancelled. If one of these sites were as good as or better than the Clinch River site from an environmental and safety standpoint, it may be substantially better than the Clinch River site due to the site preparation activities that have already been undertaken. Such a site may be better able to meet the CRBR objective of timeliness, and the overall cost may be lower.

INTERROGATORY

7(c)-5 State the reasons why an underground site is more favorable from an environmental and safety point of view, considering that the Applicants' current design for CRBR includes double containment.

RESPONSE

7(c)-5 An underground site could be constructed with a zero release objective (i.e., no venting). This is a common objective at the Nevada Test Site where the energetics associated with the disassembly of the nuclear device are substantially larger than that predicted for CRBR in the event of an energetic CDA.

INTERROGATORY

7(c)-6 This Interrogatory has been withdrawn by Staff.

NRDC Contention 8 (formerly NRDC 14)

INTERROGATORY

8-1. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

8-2. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

- 8-3. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

- 8-4. This Interrogatory has been withdrawn by Staff as duplicative of Applicant's discovery request.

INTERROGATORY

- 8-5. Identify with particularity the basis, legal or otherwise, for NRDC's contention that the Applicants and/or Staff must analyze "unavoidable" environmental effects associated with the decommissioning of CRBR.

RESPONSE

- 8-5. NEPA and 10 CFR Part 51.

INTERROGATORY

- 8-6. Define the term, "internalized economic costs," as that term is used in Contention 8.

RESPONSE

- 8-6. "Internalized economic costs" is meant to imply the normal costs of doing business quantified in monetary units (e.g., dollars) and treated explicitly in, for example, the NEPA cost/benefit analysis. As used here it refers to the actual dollar cost of decommissioning the reactor.

INTERROGATORY

8-7. List and describe all "internalized economic costs" associated with the decommissioned CRBR which NRDC believes have not been "adequately assessed" in the CRBR NEPA review. Provide the basis for NRDC's belief that these internalized costs will be associated with a decommissioned CRBR.

RESPONSE

8-7. The discussion of decommissioning in the FES is so cursory that it is impossible to determine its correctness.

INTERROGATORY

8-8. Define the term, "external social costs" as that term is used in Contention 8.

RESPONSE

8-8. External societal costs of decommissioning is meant to imply those costs to society, e.g., permanent or long-term land withdrawal and visual impacts, which are not treated as part of the actual dollar cost of decommissioning.

INTERROGATORY

8-9. List and describe all "external social costs" associated with the decommissioned CRBR which NRDC believes have not been "adequately assessed" in the CRBR NEPA review.

RESPONSE

8-9. The discussion of decommissioning in the FES is so cursory that it is impossible to determine its correctness. See response to Interrogatory 7(a) of Applicants' Fourth Set of Interrogatories to Intervenor.

INTERROGATORY

8-10 This Interrogatory has been withdrawn by Staff.

INTERROGATORY

8-11 This Interrogatory has been withdrawn by Staff.

INTERROGATORY

8-12a. Describe with particularity what NRDC believes are the inadequacies of the assessment of the economic and social costs of the decommissioned CRBR.

8-12b. Describe with particularity what NRDC believes the parties must do to "adequately analyze" the economic and social costs of the decommissioned CRBR.

RESPONSE

8-12a. See response to Interrogatory 8-9 above.

b. See second sentence of response to Interrogatory 8-9 above.

INTERROGATORY

8-13 Describe with particularity the inadequacies of the analysis of decommissioning in the Applicants' Environmental Report ("ER").

RESPONSE

8-13. Intervenors have been unable to find any analysis of decommissioning in the ER.

INTERROGATORY

8-14. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

8-15. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

8-16. Identify those sections of the CRBR FES which contain omissions analogous to the omissions which NRDC identifies and describes in the response to Interrogatory 8-13.

RESPONSE

8-16. Not applicable.

INTERROGATORY

8-17. Is NRDC aware of any revised, supplementary, or superseding report or study to the Harwood report? If so, provide NRC Staff with a copy of such document.

RESPONSE

8-17. Yes. Documents are listed in response to Interrogatory 7(a) of Applicants' Fourth Set of Interrogatories to Intervenor. Some documents were provided to Staff on April 22, 1982. Additional documents identified in 7(a) will be provided if requested.

INTERROGATORY

8-18. Does NRDC believe that Ni-59 will be present in quantities equal to that of Ni-63, or in quantities equal to one percent of Ni-63? Provide the basis for NRDC's response.

RESPONSE

8-18. Intervenor has not done an analysis sufficient to answer this question. An adequate Staff analysis would provide the necessary answer.

INTERROGATORY

8-19. This Interrogatory has been withdrawn by Staff as duplicative of Applicants' discovery request.

INTERROGATORY

8-20. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

8-21. Describe with particularity what NRDC believes the NRC Staff must do to "systematically analyze" all neutron activation products produced by CRBR.

RESPONSE

8-21. See response to Interrogatory 7(a) of Applicants' Fourth Set of Interrogatories to Intervenors.

INTERROGATORY

8-22. For the neutron activation products identified by NRDC in response to Interrogatory 8-19, identify those that NRDC contends the NRC Staff must "systematically analyze."

RESPONSE

8-22. Interrogatory 8-19 has been withdrawn by Staff.

INTERROGATORY

8-23a. Define the term, "potential isolation period" as this term is used in Contention 8(d).

b. This Interrogatory has been withdrawn by Staff.

RESPONSE

8-23a. "Potential isolation period" means the period of time the material must be isolated from the biosphere in order to prevent an undue risk to the public health and safety.



INTERROGATORY

8-24. Describe with particularity the process or method by which the potential isolation period will be factored (taken into account) into the analysis of economic and social cost associated with decommissioning. Provide the bases for NRDC's response.

RESPONSE

8-24. See response to Interrogatory 7(a) of Applicants' Fourth Set of Interrogatories to Intervenors.

NRDC Contention 11 (formerly NRDC 3)

INTERROGATORY

11-1. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-2. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-3. Specify the "current NRC standards for radiation protection of the public health and safety" that are referred to in Contention 11 by citation to specific NRC regulations or rules.

RESPONSE

11-3. 10 CFR 20, 10 CFR 50 Appendix I to the extent that a legal determination is made that it applies to LMFBRs as well as LWRs, and 10 CFR 100.

INTERROGATORY

11-4. What types of radiation from CRBR (alpha, beta, gamma or neutron) do you contend "have not been adequately analyzed by Applicants" in Contention 11?

RESPONSE

11-4. Alpha, beta, gamma and neutron.

INTERROGATORY

11-5. What types of radiation from CRBR (alpha, beta, gamma or neutron) do you contend "have not been adequately analyzed by ... Staff" in Contention 11?

RESPONSE

11-5 Alpha, beta, gamma and neutron.

INTERROGATORY

11-6 Specify the types of radioactive effluents from CRBR (i.e., airborne effluents, and/or liquid effluents) that are the sources of the exposures to radiation that you contend "have not been adequately analyzed by Applicants" in Contention 11.

RESPONSE

11-6 Airborne effluents, liquid effluents, and direct radiation exposure.

INTERROGATORY

11-7 Specify the types of radioactive effluents from CRBR (i.e., airborne effluents, and/or liquid effluents) that are the sources of the exposures to radiation that you contend "have not been adequately analyzed by ... Staff" in Contention 11.

RESPONSE

11-7 Airborne effluents, liquid effluents, and direct radiation exposure.

INTERROGATORY

11-8 For each type of radioactive effluent identified in response to questions 6 and 7, provide the bases (i.e., methodology of analysis, and any documents used in that analysis) for your statement that the particular type of radioactive effluent from CRBR has "not been adequately analyzed by Applicants or Staff."

RESPONSE

11-8 Intervenors wish to make several points. First, part of the basis for Contention 11 is set forth in subcontentions (a) through (d). Second, the FES suffers from the same type of problems as identified by the D.C. Circuit in NRDC v. NRC (No. 74-1586, April 27, 1982) relating to the discussion of the environmental impacts of the fuel cycle, e.g., no discussion of health effects and inadequate consideration of uncertainties. Third, the FES is inscrutable; the test and the references in the FES do not permit Intervenors to discern the calculations and data underlying the results. Fourth, there has been no determination of what level of release is ALARA for the LMFBRs, analogous to 10 CFR Part 50 Appendix I or 40 CFR §190.

INTERROGATORY

11-9 For each type of radiation from CRBR (i.e., alpha, beta, gamma or neutron) identified in responses to questions 4 and 5, identify the particular radionuclides that NRDC contends "have not been adequately analyzed by Applicants or Staff."

RESPONSE

11-9 All radionuclides produced in the CRBR.

INTERROGATORY

11-10 This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-11 This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-12 For each radionuclide identified in response to question 11-9, provide the basis (i.e., methodology of analysis, and any documents used in that analysis) for your statement that the particular radionuclide has "not been adequately analyzed by Applicants or Staff."

RESPONSE

11-12 The criticism of the FES analysis in response to Interrogatory 11-8 above applies with equal force to all radionuclides identified above.

Contention 11(a)

INTERROGATORY

11-13.a. This Interrogatory has been withdrawn by Staff.

Contention 11(b)

INTERROGATORY

11-14.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-14.b. Specify the parts of the body that might be exposed as the term "exposure" is used in Contention 11(b).

RESPONSE

11-14.b. Genetic effects due to radiation exposure are generally believed to be caused by the exposure of gonads and ovaries of men and women, respectively.

INTERROGATORY

11-14.c. For each part of the body that is identified in response to b. above, identify the types of radiation that you are concerned with in your contention that: "neither Applicants nor Staff have adequately assessed the genetic effects from radiation exposure."

RESPONSE

11-14.c. Alpha, beta, gamma and neutron.

INTERROGATORY

11-14.d. Where do you postulate the individuals will be located who will be exposed to radiation as the term "radiation exposure" is used in Contention 11(b).

RESPONSE

11-14.d. Principally employees exposed at the plant site, as the Contention explicitly states. Since members of the public will also be exposed to radiation released from the plant site and since some of this exposure will occur during or prior to the child bearing age, it is anticipated that there will be genetic effects from this exposure as well.

Contention 11(b)

INTERROGATORY

11-15.a. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-15.b. What are "plant employees and the public" exposed to as the term "exposure" is used in Contention 11(c)?

RESPONSE

11-15.b. Ionizing radiation.

INTERROGATORY

11-15.c. Specify the parts of the body that might be exposed as the term "exposure" is used on Contention 11(c).

RESPONSE

11-15.c. All parts.

INTERROGATORY

11-15.d. Identify the particular radionuclides for which you contend "neither Applicants or Staff have adequately assessed the induction of cancer from the exposure of ... the public."

RESPONSE

11-15.d. All radionuclides produced in the CRBR.

Contention 11(d)

INTERROGATORY

11-16.a. Specify the "guideline value for permissible organ doses" that are referred to in Contention 11(d).

RESPONSE

11-16.a. 150 rem to the bone, and 75 rem to the lung as indicated in NRC "Site Suitability Report in the Matter of the CRBRP," March 4, 1977, pp. III-14 to 16.



INTERROGATORY

11-16.b. Define "permissible organ doses" as it is used in Contention 11(d).

RESPONSE

11-16.b. The limits placed on organ exposure for the purpose of assessing the suitability of sites under 10 CFR 100.

INTERROGATORY

11-16.c. Provide the bases that support your contention that the guideline values ... have not been shown to have a valid basis.

RESPONSE

11-16.c. Intervenors have provided Staff with a detailed explanation of the basis for their current views on this matter in "Natural Resources Defense Council's Response to Objections to Contentions," March 31, 1982, pp. 9-13. See response to Interrogatory 6 of Applicants' Fourth Set of Interrogatories to Intervenors.

Contention 11(d) (1)

INTERROGATORY

11-17.a. Define "organ dose equivalent limits" as it is used in Contention 11(d) (1).

RESPONSE

11-17.a. "Dose equivalent" is defined in ICRP 26 at p. 4 paragraph (18)a. It has units of "rems." "Organ dose equivalent" is the dose equivalent for a particular organ. The limits referred to here are the limiting values for exposure to organs under 10 CFR 100.

INTERROGATORY

11-17.b. List all of the "important organs" that are referred to in Contention 11(d) (1).

RESPONSE

11-17.b. Exposure to all organs must be considered under the approach currently recommended by ICRP and adopted by EPA (and Intervenor). Given that all organs are not equally sensitive to radioactivity and ingested radionuclides are not equally distributed in all organs of the body, some organs are more significant than others in terms of the contribution to total risk. In assessing stochastic somatic effects from exposure to radionuclides from CRBR, bone, lung, liver and thyroid are particularly important.

INTERROGATORY

11-17.c. For each "important organ" listed in response to Contention 11(d) (1), state why that particular organ is important in "establishing 10 C.F.R. 100.11 organ dose equivalent limits."

RESPONSE

11-17.c. This answer follows directly from the prescription for applying the approach advocated in ICRP 26 as discussed in our response to Interrogatory 6 of Applicants' Fourth Set of Interrogatories to Intervenor.

INTERROGATORY

11-17.d. Identify by page number and paragraph number "the recommendations of the ICRP in Report 26" that are referred to in Contention 11(d) (1).

RESPONSE

11-17.d. The answer to this question will become self-evident to Staff when they apply the approach recommended in ICRP 26. You cannot determine whether the 10 CFR 100 limit is met without considering all organs listed at p. 3 of EPA, "Proposed Federal Radiation Protection Guidance for Occupational Exposure," EPA 520/4-81-003, Jan. 16, 1981.

INTERROGATORY

11-17.e. Identify by page number and paragraph number "the recommendations of the ICRP in Report ... 30" that are referred to in Contention 11(d) (1).

RESPONSE

11-17.e. ICRP 26, pp. 14-26, particularly paragraphs (104) to (110).

ICRP 30, Chapter 2.

EPA 520/4-81-003, supra, particularly at p. 3.

INTERROGATORY

11-17.f. This Interrogatory has been withdrawn by Staff.

11-17.g. This Interrogatory has been withdrawn by Staff.

11-17.h. This Interrogatory has been withdrawn by Staff.

Contention 11(d) (2)

INTERROGATORY

11-18.a. This Interrogatory has been withdrawn by Staff.

11-18.b. This Interrogatory has been withdrawn by Staff.

INTERROGATORY

11-18.c. Provide the most recent references to the "plutonium 'hot particle' hypothesis" advanced by Arthur R. Tamplin and Thomas B. Cochran.

RESPONSE

11-18.c. Intervenor's assume the question seeks to identify the principal reports by Tamplin and Cochran and not review articles by others. The principal documents by Tamplin and Cochran on this subject are:

- 1) Radiation Standards for Hot Particles, February 14, 1974.
- 2) NRDC Comments on WASH-1535, DRAFT EIS LMFBR Re Volume II, Part 2, Section 4.6.5, Particle Lung Dose Effects, reprinted in ERDA-1535, pp. V.55-1 to V.55-328.
- 3) The Hot Particle Issue: A Critique of WASH-1320 as it relates to the Hot Particle Hypothesis, November 1974.
- 4) "A Critique of the Biophysical Society DRAFT Comments on 'Radiation Standards for Hot Particles'", December 1974.
- 5) "NRDC Supplemental Submission to the EPA Public Hearings on Plutonium and the Transuranic Elements," February 24, 1975.
- 6) "Comments by NRDC on the NRC's Denial of Petition for Rule Making [Docket No. PRM-20-50]" June 2, 1976.
- 7) NRDC testimony in the GESMO Proceeding (Doc. RM-50-5); Re: Chapter IV, Section J, Appendix D, March 4, 1977, Prepared by Arthur R. Tamplin and Thomas B. Cochran, March 4, 1977.

- 8) "Natural Resources Defense Council Critique of the NAS-NAC Report, 'Health Effects of Alpha-Emitting Particles in the Respiratory Tract", March 1977.

INTERROGATORY

11-18.d. Provide the most recent references to the hypothesis advanced by ... Karl Z. Morgan."

RESPONSE

11-18.d. The only more recent reference to the hypothesis advanced by Karl Z. Morgan referred to in Contention 11(d) (2) known to Intervenor at this time is a letter from Karl Morgan to Robert E. Alexander, NRC Staff, dated May 5, 1976. This should be available in Staff files; otherwise Intervenor will provide a copy.

INTERROGATORY

11-18.e. Identify the parts of the human body in which "neither Applicant or Staff have given adequate consideration of the plutonium 'hot particle' hypothesis."

RESPONSE

11-18.e. Lung.

INTERROGATORY

11-18.f. For each part of the human body listed in response to e. above, provide the bases (i.e., methodology of analysis, and any documents (include page numbers and paragraph numbers) used in that analysis) for your statement that "neither Applicant nor Staff have given adequate consideration to the plutonium 'hot particle' hypothesis" for that particular body organ.

RESPONSE

11-18.f. The hot particle hypothesis as advanced by Tamplin and Cochran was first set forth in reference 1) under Interrogatory 11-18.c. above. This work was supplemented in reference 5) above and a new particle standard equivalent to 5 rem/yr was recommended in this same reference. References 3), 4), 6), and 7) represent critiques of reports that disagreed with the hypothesis as advanced by Tamplin and Cochran.

Interrogatories Related to Requests for Admissions

The following interrogatories relate to the Staff's requests for admissions which immediately follow these interrogatories.

1. For each statement identified in the following requests for admissions which you deny, provide the following information:

- a.) The portion of statement which is not admitted.
- b.) The basis of your disagreement with the statement.
- c.) The expert witnesses, if any, you are relying on in disagreeing with the statement.
- d.) The document, if any, you are relying on in disagreeing with the statement.
- e.) The articles, if any, you are relying on in disagreeing with the statement.

2. Regarding requests for admissions numbers 1 and 2 under Contentions 4 and 6, provide the following additional information:

If NRDC does not admit to Admissions 1 or 2 (or both) below, state specifically what factors about the design or siting of CRBR make it impossible or impracticable to protect against the design basis threats in 10 C.F.R. 73.1(a) (1) and (2).

3. If NRDC does not admit (or objects to) Admission 1 related to Contention 7, following these interrogatories, state specifically every alternative design which NRDC believes must be considered for CRBR.



REQUEST FOR ADMISSIONS

Pursuant to 10 C.F.R. § 2.742, the NRC Staff requests admissions by NRDC et al. of the following matters of fact:

Regarding Contentions 4 and 6

REQUEST

1. From a factual (as opposed to legal) standpoint, there is nothing about the CRBR design or site which would make it technically impossible to have a safeguards and security system adequate to protect against the design basis threats in 10 C.F.R. 73.1 (a) (1) and (2).

RESPONSE

1. Intervenors can neither admit n or deny this statement since we have not completed the necessary review for the following reasons. Data in the 1977 FES is inadequate to enable Intervenors to make such a determination. Staff has responded to our discovery requests on this issue by stating that such information is not necessary to an LWA-1 proceeding. See, e.g., updated response to Interrogatory 7 of Intervenors Sixth Set of Interrogatories to Staff, and updated response to Interrogatories IV-4, V-2, 3, 5, 6, and VII-6 of Intervenors Eighth Set of Interrogatories to Staff.

REQUEST

2. From a factual (as opposed to legal) standpoint, there is nothing about the CRBR design or site which would make it technically impracticable to have a safeguards and security system adequate to protect against the design basis threats in 10 C.F.R. 73.1(a) (1) and (2).

RESPONSE

2. Intervenors can neither admit nor deny this statement since we have not completed the necessary review for the following reasons. Data in the 1977 FES is inadequate to enable Intervenors to make such a determination. Staff has responded to our discovery requests on this issue by stating that such information is not necessary to an LWA-1 proceeding. See, e.g., updated response to Interrogatory 7 of Intervenors Sixth Set of Interrogatories to Staff, and updated response to Interrogatories IV-4, V-2, 3, 5, 6, and VII-6 of Intervenors Eighth Set of Interrogatories to Staff.

REQUEST

3. Assuming a design basis act comparable to the threats described in 10 C.F.R. 73.1(a) (1) and (2) occurs, there is nothing about the CRBR design which would make it significantly more difficult to defend against that act than an LWR at the same site.

RESPONSE

3. Intervenors can neither admit nor deny this statement since we have not done such a comparative assessment.

REQUEST

4. Assuming a design basis act comparable to the threats described in 10 C.F.R. 73.1(a) (1) and (2) occurs, there is nothing about the CRBR site which makes it particularly difficult to defend the site against that act.

RESPONSE

4. Intervenors can neither admit nor deny this statement since Applicants have not defined the term "particularly difficult" with sufficient specificity.

REQUEST

5. The environmental impacts, excluding dollar costs, from safeguards during the CRBR fuel cycle will not be significantly different from the environmental impacts from safeguards during the fuel cycle for an LWR, assuming the reprocessing and recycling of fuel in both fuel cycles.

RESPONSE

5. Intervenors deny this statement. Fresh CRBR fuel, unlike recycled MOX for LWRs, is directly weapons

usable. LMFBR fuel reprocessing plants differ significantly in size and design from LWR fuel reprocessing plants. See NASAP Report, Vol. II.

REQUEST

6. The environmental impacts during the CRBR fuel cycle (excluding waste disposal) will not be significantly different from the environmental impacts from the fuel cycle (excluding waste disposal) for an LWR fuel cycle, assuming the reprocessing and recycling of fuel in both fuel cycles.

RESPONSE

6. Intervenors can neither admit nor deny this statement since Staff and Applicants have yet to provide Intervenors a complete description of the CRBR fuel cycle facilities.

REQUEST

7. The environmental impacts from waste disposal for the CRBR fuel cycle, although the content of the waste may be different, will not result in environmental impacts significantly different from impacts for the waste from the LWR fuel cycle for any waste disposal plan which has been proposed for nuclear waste products, assuming the reprocessing and recycling of fuel in both fuel cycles.

RESPONSE

7. Intervenors can neither admit nor deny this statement without knowing whether CRBR waste will be treated as defense waste or commercial waste. If Applicants' claim is correct that the CRBR waste will be treated as commercial waste, Intervenors admit this statement.

Regarding Contention 7

REQUEST

1. In addition to the technical matters raised in admitted Contentions, other than new Contention 7, the only alternative designs NRDC believes must be considered for CRBR which NRDC believes have not yet been adequately considered are:
  - a) fly wheels on the sodium pumps
  - b) a core catcher
  - c) the parfait core

RESPONSE

1. Intervenors deny this statement. Other alternative designs include those found in LMFBRs of the general size and type as the CRBR, and those identified by members of the technical (i.e., fast reactor and reactor safety) community. Intervenors have not performed a literature search to identify these designs but believe Staff is required by NEPA and the ALARA principle to conduct such a review.

REQUEST

2. If the CRBR is built and operates as presently planned, without any technical difficulties (excluding the question of timeliness), the project will meet the objectives of the LMFBR Program.

RESPONSE

2. Assuming that the planned demonstration period is 5 years as Applicants claim, Intervenor deny this statement on the basis that such demonstration period is not long enough to demonstrate programmatic objectives.

REQUEST

3. If the CRBR is built and operates as presently planned, without any technical difficulties, it will meet the LMFBR program objectives in a timely manner.

RESPONSE

3. Intervenor deny this statement for reasons set forth in response to Request for Admission 2 above.

REQUEST

4. It is not necessary from a factual (as opposed to legal) standpoint to consider every alternative design feature used at foreign breeders to design a breeder reactor which will meet the programmatic objectives of the LMFBR Program.

RESPONSE

4. Intervenors admit this statement.

Regarding NRDC Contention 11 b) -d):

The following admissions contemplate normal operation of the CRBR, including expected operational occurrences.

REQUEST

1. The annual dose to the whole body of an individual from exposure to natural background radiation (i.e., cosmic radiation, terrestrial radiation, and internal sources) in the state of Tennessee is about 0.1 rem.

RESPONSE

1. Intervenors admit this statement, noting however, that Intervenors have not examined the natural background radiation level in the state of Tennessee, but agrees that 0.1 rem is correct to one significant figure for the United States. Intervenors have no basis for believing it is not also the correct value for Tennessee.

REQUEST

2. The annual dose to the whole body of an individual from exposure to natural background radiation (i.e., cosmic radiation, terrestrial radiation, and internal sources) in the U.S. varies from about 0.1 rem to about 0.3 rem, depending on location.

RESPONSE

2. Intervenors admit this statement, recognizing that the doses are given only to one significant figure.

REQUEST

3. The National Academy of Sciences, BEIR III Report estimates that the whole body dose to the population within 10 miles of commercial nuclear power plants exposed to radioactive effluents releases is much less than 0.01 rem/yr.

RESPONSE

3. Intervenors admit that this statement is a reasonable interpretation of the data presented in BEIR III, Table 3-23, at p. 66, and appears to be based on Reference 11 at p. 68. Intervenors note that such estimate does not represent original work of the BEIR III committee.

REQUEST

4. The quantities of airborne radioiodines and particulates that are likely to be released from CRBR are less than the quantities released from operating LWRs.

RESPONSE

4. Intervenors admit this statement only with respect to normal CRBR operation (i.e., routine releases)



exclusive of the balance of the fuel cycle, but also note that the CRBR was initially sold to the public and the Congress on the basis that the routine releases from the CRBR would be zero. This objective of the CRBR was never met.

REQUEST

5. The total quantities of liquid and gaseous radioactive effluents (Ci/yr) for the CRBR are likely to be smaller than those for most operating LWRs.

RESPONSE

5. Intervenors admit this statement only with respect to normal CRBR operation (i.e., routine releases) exclusive of the balance of the fuel cycle, provided "total quantity" (Ci/yr) is taken to mean the sum over all radionuclides.

REQUEST

6. It is most likely that there will be no measurable transuranic elements released from the CRBR via the gaseous pathway during normal operation.

RESPONSE

6. Intervenors deny this statement. The state of the art in monitoring radioactivity would permit detection of transuranic activity released from the CRBR, even under

normal operation, if the appropriate monitoring equipment and techniques were utilized. Intervenors do not believe, however, that environmental monitoring is adequate at most power reactors and isn't holding out any great hopes for the CRBR. Setting all this aside, Intervenors admit that routine releases of transuranics in gaseous pathways from CRBR could be kept sufficiently low so as not to be a significant concern compared to all the other problems with the CRBR.

#### REQUEST

7. The annual doses to the total body and each body organ of offsite individuals potentially exposed to routine releases of airborne radioactive effluents during normal operation from CRBR will be less than the corresponding doses from most operating LWRs.

#### RESPONSE

7. Intervenors hope so but cannot admit or deny this statement. The monitoring of routine airborne radioactive releases from LWRs are not adequate to accurately determine the releases from the median LWR, and the projected releases from CRBR may be considerably different from the actual releases. Furthermore, Intervenors have not made a comparative assessment of the doses to each body organ from routine airborne releases from the CRBR and the median LWR.

REQUEST

8. The annual doses to the total body and each body organ of offsite individuals potentially exposed to routine releases of radioactive liquid effluents from CRBR will be less than the corresponding annual doses from exposure to natural background radiation in the state of Tennessee.

RESPONSE

8. Intervenors cannot admit or deny this statement. The projected releases from CRBR may be considerably different from the actual releases. Furthermore, Intervenors have not made a comparative assessment of the doses to each body organ from routine liquid effluents from the CRBR and natural background radiation in the state of Tennessee. It may be of interest to Staff to recognize that much of the radioactivity already in the Clinch River in the area of the proposed CRBR site is not natural background, but due to prior releases by Applicants from ORNL via White Oak Creek. In determining compliance with 10 C.F.R. Part 20, doses from all licensed and unlicensed activities must be added to the doses from CRBR liquid effluents.

REQUEST

9. The annual doses to the total body and each body organ of offsite individuals potentially exposed to routine releases of radioactive noble gases from CRBR will be less than the corresponding annual doses from exposure to natural background radiation in the state of Tennessee.

RESPONSE

9. Intervenors admit this statement, but note that the CRBR was originally sold to the public and the Congress on the basis that all noble gases would be bottled and the routine noble gas releases would be essentially zero. See, e.g., WASH-1509, p. 51. Furthermore, Intervenors do not believe that Applicants, or Staff, have demonstrated that the current design permitting noble gas release is in accord with the principle of ALARA.

REQUEST

10. The annual doses to the total body and each body organ of offsite individuals potentially exposed to routine releases of airborne radioactive iodines and particulate effluents from CRBR will be less than the corresponding annual doses from exposure to natural background radiation in the state of Tennessee.

RESPONSE

10. Intervenors cannot admit or deny this statement. The projected airborne particulate releases from CRBR may be considerably different from the projected releases. Furthermore, Intervenors have not made a comparative assessment of the doses to each body organ from routine releases of radioactive iodine and particulate effluents from the CRBR and natural background radiation.

REQUEST

11. Neither the National Academy of Sciences BEIR III Committee, the National Council of Radiation Protection and Measurements, or the International Committee on Radiological Protection has endorsed "the plutonium 'hot particle' hypothesis" referenced in NRDC Contention 11.d) (2).

RESPONSE

11. Intervenors admit this statement.

REQUEST

12. No authoritative radiation protection organization in the world with expertise in the area of potential health effects from ionizing radiation has endorsed "the plutonium 'hot particle' hypothesis."

RESPONSE

12. Intervenors can neither admit nor deny this statement, as we have not polled every authoritative radiation protection organization in the world.

REQUEST

13. During normal operation of CRBR, the maximally exposed individual in the general public exposed to radioactive noble gases in the plume from the CRBR would be situated at the CRBR site boundary.

RESPONSE

13. Intervenors deny this statement, however we recognize that this is a reasonable assumption for purposes of modelling the radiological risks associated with CRBR operations.

REQUEST

14. The meteorological dispersion factor at the nearest CRBR site boundary for exposure to continuous releases during normal operation of the CRBR would be about  $10^{-4}$  sec/m<sup>3</sup> or less.

RESPONSE

14. Intervenors can neither admit nor deny this statement because we have not estimated or analyzed the meteorological dispersion factor at the nearest CRBR site boundary.

REQUEST

15. The nearest site boundary for CRBR would be about 0.4 miles from the facility.

RESPONSE

15. Intervenors admit this statement.

REQUEST

16. During normal operation of the CRBR, the average dose to the population within 50 miles of CRBR exposed to airborne radioactive effluents would be less than the 10 C.F.R. 50 Appendix I dose design objectives for the maximally exposed individual by about two orders of magnitude or more.

RESPONSE

16. Intervenors can neither admit nor deny this statement since we have not performed or examined the comparative assessment.

REQUEST FOR DOCUMENTS

Pursuant to 10 C.F.R. § 2.741, the Staff requests NRDC et al. to produce the following documents:

1. Letter, dated January 27, 1982, from Richard Shiklar, Director, Social Change Study Center, to Dr. Thomas Cochran, NRDC, referenced at page 3, section c, of "New Information Relevant to Intervenor's Contentions." The "New Information ..." document was attached to a letter dated March 12, 1982 from counsel to NRDC to counsel to the NRC Staff and Applicants.

RESPONSE

This document was supplied to Staff on April 22, 1982.

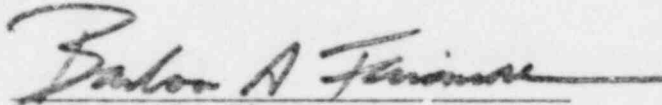
2. The report by S. Harwood, May, K., Resnikoff, M., Schlenger, B., and Tames, P., entitled, "Decommissioning Nuclear Reactors" referenced in Contention 8.c).

RESPONSE

This document was supplied to Staff on April 22, 1982.



Respectfully submitted,



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S. Jacob Scherr  
Natural Resources Defense  
Council, Inc.  
1725 Eye Street, NW  
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Attorneys for Intervenors  
Natural Resources Defense  
Council, Inc., and the  
Sierra Club

May 6, 1982  
Washington, D.C.

BEFORE THE UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ATOMIC SAFETY AND LICENSING BOARD

In The Matter of )

UNITED STATES DEPARTMENT OF ENERGY )  
PROJECT MANAGEMENT CORPORATION )  
TENNESSEE VALLEY AUTHORITY )

Docket No. 50-537

Clinch River Breeder Reactor Plant )

AFFIDAVIT OF DR. THOMAS B. COCHRAN

I, Dr. Thomas B. Cochran, being duly sworn, depose and say:

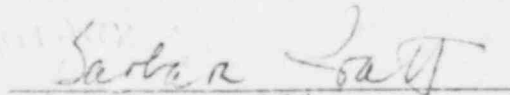
1. I am employed as a Senior Staff Scientist by the Natural Resources Defense Council, Inc., and, as such, I am duly authorized to execute the foregoing answers to interrogatories.

2. The foregoing answers are true and correct to the best of my knowledge and belief.



Dr. Thomas B. Cochran

Subscribed and sworn to before me  
this 5th day of May 1982.

  
Notary Public

October 1, 1981

RESUME

Thomas B. Cochran, Ph.D.

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EMPLOYMENT HISTORY

April 1973-present: Natural Resources Defense Council, Inc.

Senior Staff Scientist, focusing on national energy R&D policy, principally nuclear energy issues, the breeder reactor, plutonium recycle, nuclear weapons proliferation, safeguards, and radiation exposure standards. Consultant to the U.S. Department of Energy (DOE) on nuclear nonproliferation and nuclear R&D strategy; consultant to the Comptroller General on (a) U.S. and international controls over the peaceful uses of nuclear energy, (b) Advanced Nuclear Technologies, and (c) U.S. Liquid Metal Fast Breeder Reactor Program; consultant to the Office of Technology Assessment (OTA); Member of DOE's Energy Research Advisory Board, DOE's Nonproliferation Advisory Panel, OTA's Advisory Panel on Nuclear Proliferation and Safeguards, the Nuclear Task Group of OTA's Analyses of the ERDA Plan and Program, and OTA's Gas Curtailment Study Review Panel. Consultant to Governor of Lower Saxony, West Germany, to serve as an International Expert in the Review of the Gorleben Nuclear Fuel Cycle Center. Served as a member of ERDA's LMFBR Review Steering Committee, the National Academy of Sciences' Panel on Strategy for Developing Nuclear Merchant Ships, the Task Force on Energy Conversion Research and Development of the Federal Power Survey, the United Nations' Environment Programme's International Panel of Experts on Energy and the Environment, the National Council of Churches' Energy Study Panel and the World Council of Churches Consultation on Ecumenical Concerns in Relation to Nuclear Energy. Also served as a consultant to Resources for the Future and numerous environmental organizations. Testified before Congress and federal agency hearings on numerous occasions, including testimony before the Joint Committee on Atomic Energy, the House Committee on Interior and Insular Affairs, the Joint Economic Committee, the House Committee on Small Business, and the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards.

June 1971-April 1973: Resources for the Future, Inc.  
Washington, D.C.

Senior Research Associate, Quality of the Environment Program.  
Studying environmental effects of the U.S. civilian nuclear power industry, residuals management in the nuclear fuel cycle, liquid metal fast breeder reactor program, national energy policy, and radiation standards. Wrote a book, The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique.

1969-1981: Litton Mellonics Division, Scientific Support Laboratory  
Fort Ord. California

Modeling and Simulation Group Supervisor. Supervised the activities of 10 operation research analysts engaged in military research pertinent to the evaluation of proposed U.S. Army concepts and material by U.S. Army CDCEC.

1967-1969: U.S. Naval Postgraduate School  
Monterey, California

Lt-USNR, Active Duty; Assistant Professor of Physics; Radiation Safety Committee; part-time research involving computer studies of synchrotron radiation production in beam transport systems at Stanford Linear Accelerator, Stanford, California.

#### EDUCATION

Summer 1969: University of Colorado, Boulder. Postdoctorate.  
Summer Institute of Theoretical Physics.

1965-1967: Vanderbilt University, Nashville, TN. Doctorate.  
Major: Physics. Minor: Mathematics. Research in high energy (bubble chamber) physics. NASA Fellowship. Guest Research Associate in Physics Department at Brookhaven National Laboratory, Upton, NY, studying synchrotron radiation shielding problems.

1962-1965: Vanderbilt University. MS degree in Physics.  
Research in radiation chemistry; AEC Health Physics Fellow; applied health physics training, Oak Ridge National Laboratory; Vanderbilt University Campus Radiation Safety Officer.

1958-1962: Vanderbilt University. BE degree in Electrical Engineering, cum laude. NROTC.

#### PROFESSIONAL AFFILIATIONS

American Physical Society  
American Nuclear Society

Health Physics Society  
Sigma Xi

#### PERSONAL

Age: 40. Birth date: 18 November 1940. Birth place: Wash. DC.  
Wife: Carol J. Cochran. Two children.

CERTIFICATE OF SERVICE

I hereby certify that copies of RESPONSE OF INTERVENORS, NATURAL RESOURCES DEFENSE COUNCIL, INC. AND THE SIERRA CLUB, TO NRC STAFF FIRST ROUND OF DISCOVERY TO NRDC, ET AL., and RESPONSE OF NATURAL RESOURCES DEFENSE COUNCIL, INC. AND THE SIERRA CLUB TO APPLICANTS' FOURTH SET OF INTERROGATORIES were served this 6th day of May 1982 on the following:

- \* Marshall E. Miller, Esquire  
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Atomic Safety & Licensing Board  
U.S. Nuclear Regulatory Commission  
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Bethesda, Maryland 20814
- \* Mr. Gustave A. Linenberger  
Atomic Safety & Licensing Board  
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- \* Daniel Swanson, Esquire  
Stuart Treby, Esquire  
Bradley W. Jones, Esquire  
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Maryland National Bank Building  
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- \* Atomic Safety & Licensing Appeal Board  
U.S. Nuclear Regulatory Commission  
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- \* Atomic Safety & Licensing Board Panel  
U.S. Nuclear Regulatory Commission  
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- \* Docketing & Service Section  
Office of the Secretary  
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(3 copies)

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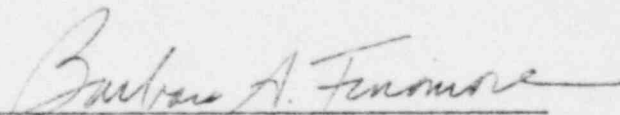
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Barbara A. Finamore

\* Denotes hand delivery.